

4TH YEAR IAMT PROJECT: RHARIS: RESIDENTIAL HIGH-RISE AUTOMATED REFUSE SEPARATOR

Introduction

The fourth-year Integrated Advanced Manufacturing Technologies (IAMT) project is a Residential High-Rise Automated Refuse Identifier Separator (RHARIS), which is capable of accepting, identifying, separating and storing all refuse outputted from a residential high-rise. Through this project, the students aimed to provide innovative, environmental, and socially-economical solutions to environmental refuse management problems in growing municipalities. A simulated example of product development, business theory and product manufacturing.

Needs Statement

Residential High-Rise Towers currently have very little refuse management capabilities. This limitation not only discourages residents from obeying instructed recycling protocols, but also perpetuates the misuse of available resources. A cost-effective, multi-dimensional solution must be developed to obstruct the current waste of materials, and ultimately promote a 'green' way of life in High-Rise structures.

Highlighted Needs

- Separate recyclables, compost and garbage
- Easy access chutes on every floor of the building
- Automated separation and material transfer
- Ground level location for loading bay access
- Quiet operation and limited maintenance
- System monitoring and personnel/tenant training
- Compact design
- Safe operation/access to chutes/maintenance
- Bylaw conformity
- Conformance to waste management and high-rise regulations

Integrated Sub-Systems

1. Floor Level Chutes (Fig. 2)
2. Compost and Organic Disposal System (Fig. 3)
 - a. A Sink Garburator in Every Apartment (Fig. 1)
 - b. A Large, Single-Blending, Ground Level Container
3. Fully Automated Recycle-Refuse Sorting Machine (Fig. 4)



Bay Adelaide West, Toronto, ON

Findings & Conclusions

The Product

RHARIS, the Residential High-Rise Automated Refuse Identifier Separator is a complex system of components merged together to handle all categories of waste which may be outputted by tenants in a high-rise building. The project contains the research and product design, the business planning and the simulated production process of a company producing the RHARIS.

The main proponents of the product are 1. The Floor-Level Chutes, 2. The Compost Fluid Extractor and 3. The Automated Recyclables Separator. Together, these three products migrate into one RHARIS system, which may be readily distributed to customers. Details of each individual are presented below.

1. Floor-level Chutes

Each standard chute assembly acts as the medium which translates all land-fill destined waste, and recyclable refuse from one floor, to the bottom of high-rise building. Due to the height of a high-rise building, and the danger accompanying it, the team has implemented a series of safety measures to protect against unlikely situations. A scheduling system has been developed in order to maximize machine run-time efficiencies as well as standardize the processing cycle.

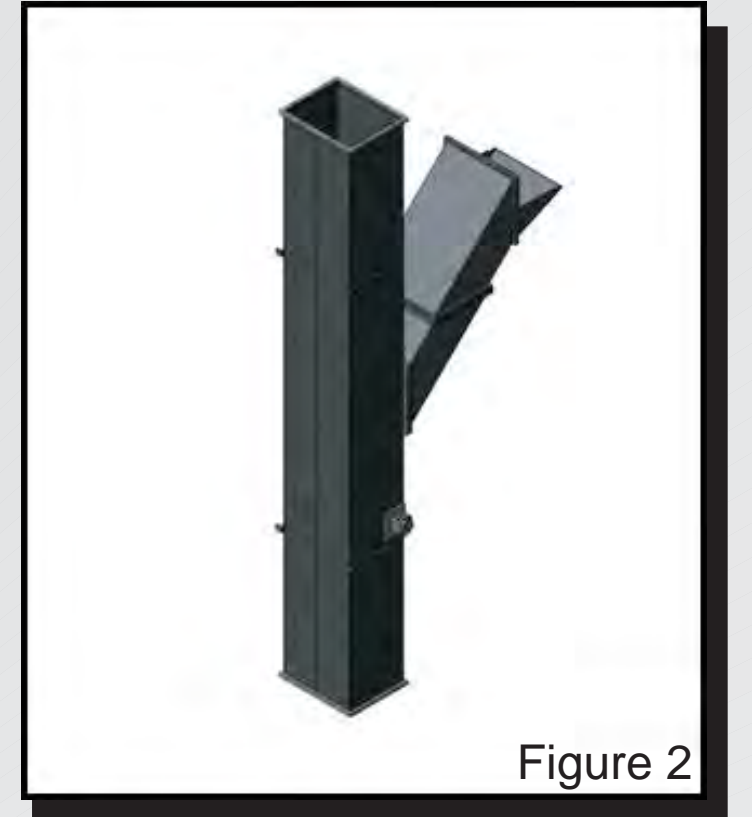


Figure 2

2. Compost Fluid Extractor

The purpose of this component is to process the food-based organics which are perpetuated through the high-rise building, coming from each sink garburator; the extractor essentially separates liquids from solids. The intent is that the liquids be deposited into a sanitary drain, and the solids either sold, or used as a renewable energy source (compost).

Similar to the Recyclables Separator, this component is an original, student-manufactured design but has similar functions to that of a tomato juicer.

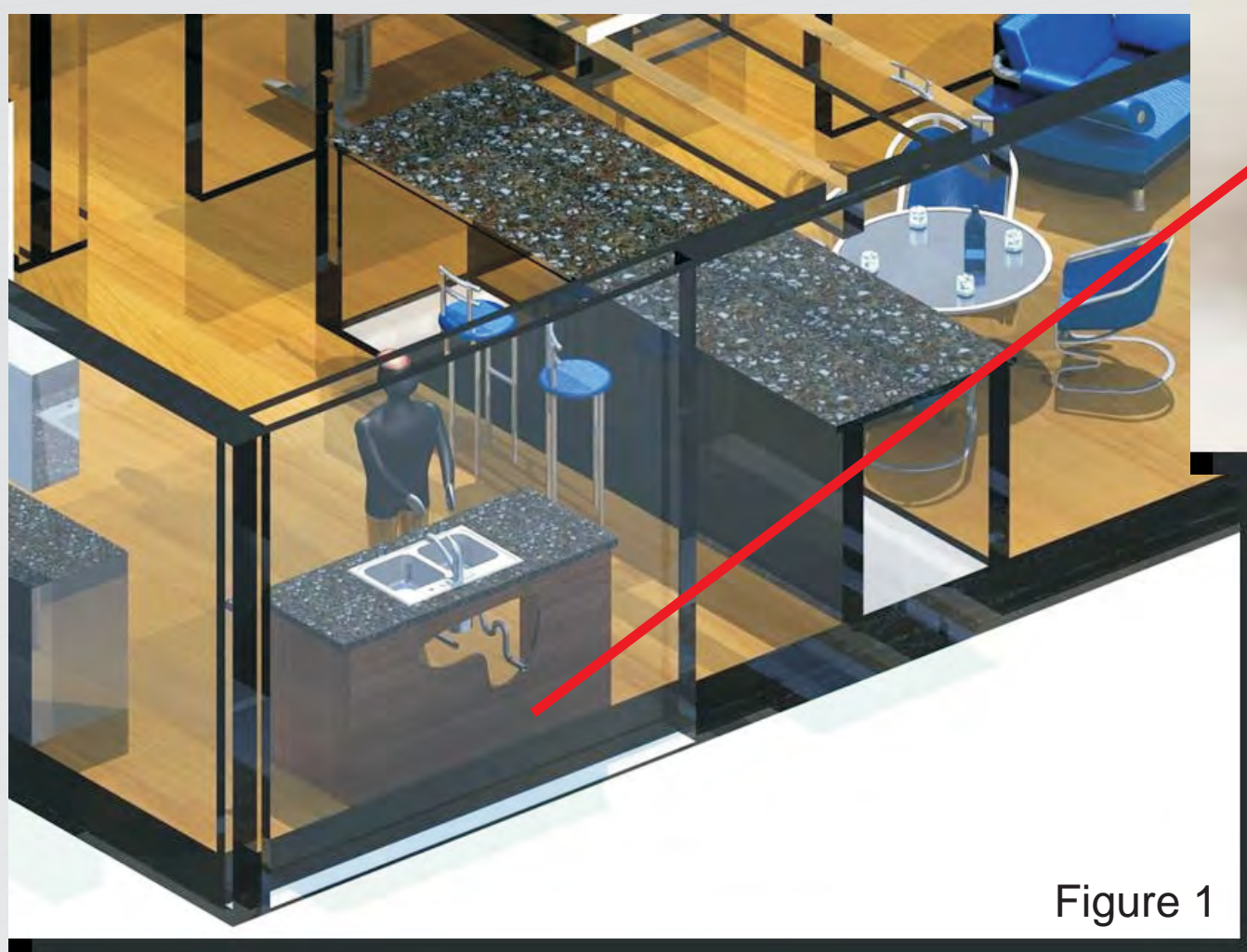


Figure 1

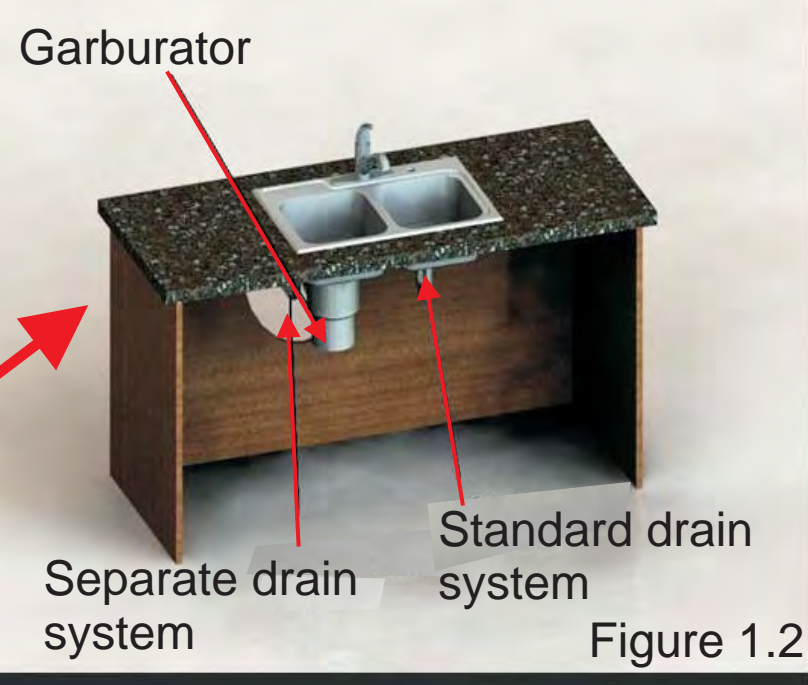


Figure 1.2

A sink Garburator will be installed in every Apartment.

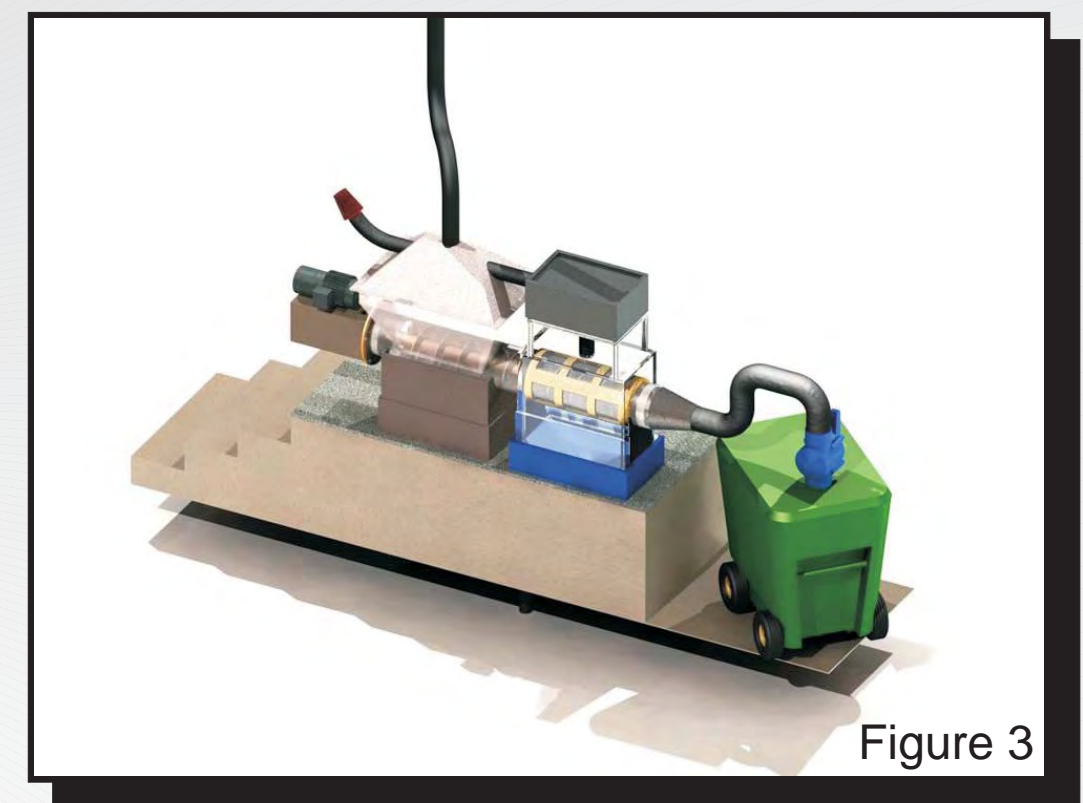


Figure 3

3. Automated Recyclables Separator

This semi-autonomous machine is situated at the bottom of the floor-level chutes; it has been designed to accept all deposited recyclable material, and systematically separate it into four general categories. Due to the coarse degree of separation, an operator is needed to check for any inconsistencies within the sort, to empty the machine and to conduct preventative and regular maintenance on it.

Even though some human interjections are required at the later stages of the cycle, this product is an original concept unlike any other within the recycling industry today. Student designed, it has the capacity for future revisions, but the team is confident of its engineering and realism within the final product.

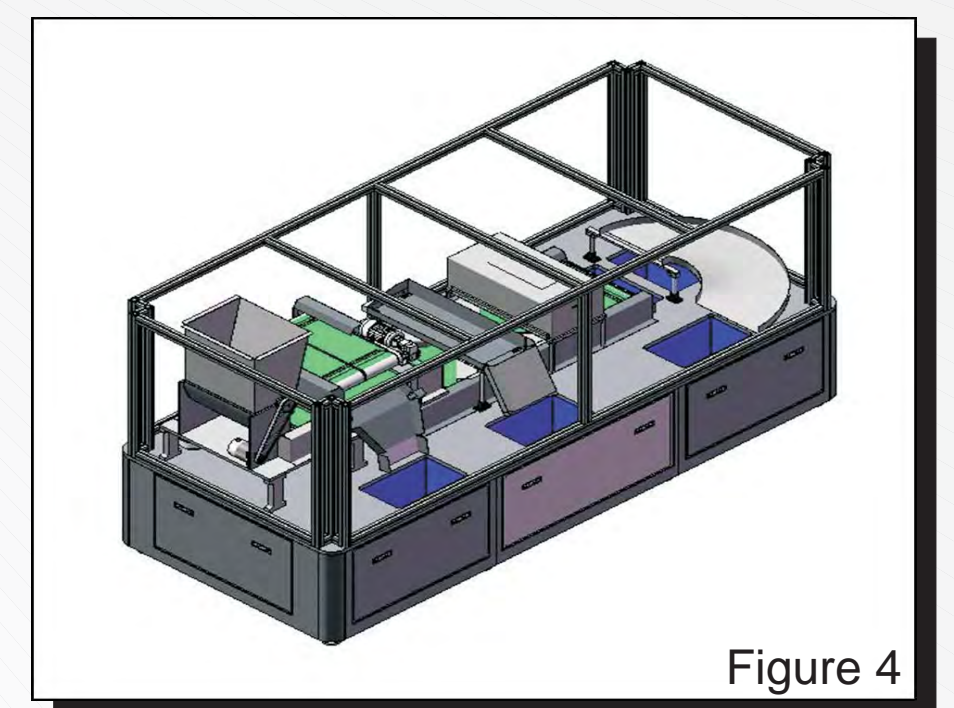


Figure 4

Abstract

The project's theme is bringing a new product to market: an automated system for identifying and separating household "garbage" collected from multiple consumers in a high-rise residence. The system allows the residents to dispose of all materials via floor-level chutes and without conducting any manual garbage sorting. The system is self contained and receives, identifies and sorts garbage as recyclable, compostable or destined for landfill. The design work includes all transfer systems, from local input to local output, as well as the sensors and controls required for the classification and sorting functions.

Keywords: Environmental Concerns; Waste Management; Compost and Organic Disposal System; Automated Recycle-Refuse Separator; Floor-level Chutes; Sink Garburator.

Quality Functional Deployment Matrix

HOWs	WHATs	Customer Importance Rating		HOWs		WHATs		HOWs	WHATs	HOWs	WHATs
		Absolute	Relative	Absolute	Relative	Absolute	Relative				
1	242	336	109	0	101	204	208	77	80	167	100
2	10	30	109	0	101	204	208	77	80	167	100
3	30	109	0	101	204	208	77	80	167	100	100
4	10	30	109	0	101	204	208	77	80	167	100
5	30	109	0	101	204	208	77	80	167	100	100
6	10	30	109	0	101	204	208	77	80	167	100
7	30	109	0	101	204	208	77	80	167	100	100
8	10	30	109	0	101	204	208	77	80	167	100
9	30	109	0	101	204	208	77	80	167	100	100
10	10	30	109	0	101	204	208	77	80	167	100
11	30	109	0	101	204	208	77	80	167	100	100
12	10	30	109	0	101	204	208	77	80	167	100
13	30	109	0	101	204	208	77	80	167	100	100
14	10	30	109	0	101	204	208	77	80	167	100
15	30	109	0	101	204	208	77	80	167	100	100
16	10	30	109	0	101	204	208	77	80	167	100
17	30	109	0	101	204	208	77	80	167	100	100
18	10	30	109	0	101	204	208	77	80	167	100
19	30	109	0	101	204	208	77	80	167	100	100
20	10	30	109	0	101	204	208	77	80	167	100
21	30	109	0	101	204	208	77	80	167	100	100
22	10	30	109	0	101	204	208	77	80	167	100
23	30	109	0	101	204	208	77	80	167	100	100
24	10	30	109	0	101	204	208	77	80	167	100
25	30	109	0	101	204	208	77	80	167	100	100
26	10	30	109	0	101	204	208	77	80	167	100
27	30	109	0	101	204	208	77	80	167	100	100
28	10	30	109	0	101	204	208	77	80	167	100
29	30	109	0	101	204	208	77	80	167	100	100
30	10	30	109	0	101	204	208	77	80	167	100
31	30	109	0	101	204	208	77	80	167	100	100
32	10	30	109	0	101	204	208	77	80	167	100
33	30	109	0	101	204	208	77	80	167	100	100
34	10	30	109	0	101	204	208	77	80	167	100
35	30	109	0	101	204	208	77	80	167	100	100
36	10	30	109	0	101	204	208	77	80	167	100
37	30	109	0	101	204	208	77	80	167	100	100
		HOW MUCH		Absolute Importance		Relative Importance					
				6271		6271					

The Project

First, the team defined the scope of the project, and the characteristics of the final product – determined from a series of design analysis and Quality Functional Deployment matrices. This outline assisted in driving the business plan design, which would herald a much less technical side to the product, but still produce an essential deliverable. A detailed product design was completed, assembling all outsourced and in-house manufactured components together into a working model. Finally, the final product was broken down once again, and a manufacturing/assembly plan was realized. To conclude the study, a business plan review was conducted to measure the difference between original plans, and final positions.

Authors:

IAMT Year 4 students: Jessica Bailey, Adam Smart, Justin Krulicki, Jay McLean, Benjamin Vanderloo, Edward Gunawan, Eric Wright, Pearce Fabian.

Faculty:

Andrew Campbell, M.Sc., P.Eng., Department of Mechanical Engineering
Conestoga College Institute of Technology and Advanced Learning,
Telephone: 519-748-5220 Ext. 2233
Email: acampbell@conestogac.on.ca

Dr. Liviu Radulescu, P.Eng., Department of Mechanical Engineering,
Conestoga College Institute of Technology and Advanced Learning,
Telephone: 519-748-5220 Ext. 2281
Email: lradulescu@conestogac.on.ca